Chemical Activation of Lunar Dust Specimens and Simulants

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What Does "Chemical Reactivity" Mean?

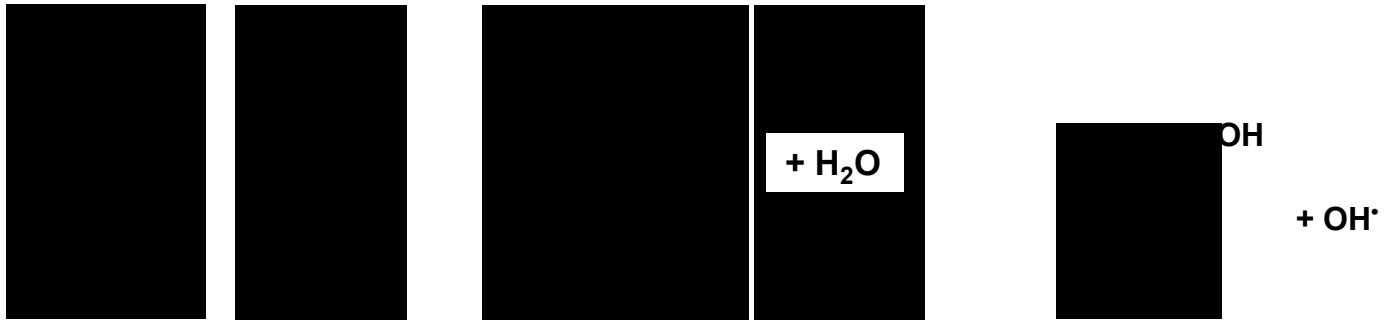
"Chemical Reactivity" means surface radicals that can interact with oxygen and water.

Potential sources of surface radicals on *in situ* lunar dust:

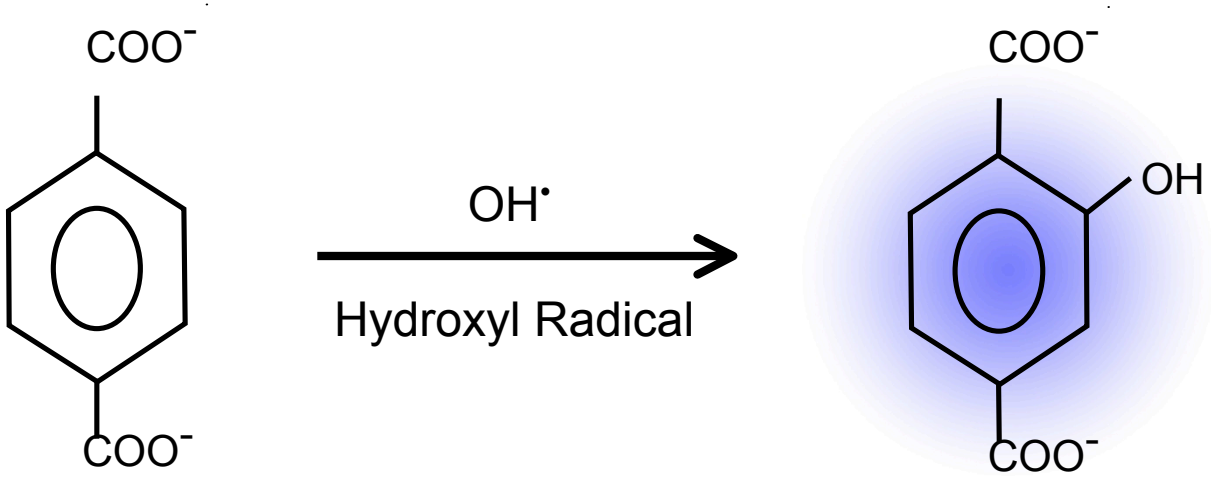
- Mechanical effects — grinding, and breaking
- Radiation effects — Full Spectrum UV
  Solar wind protons (1keV)
  GCR protons (~1GeV)
  SPE protons (15-250MeV)

Hydroxyl Radical Generation on Mineral Surfaces

Adapted from Fubini 2003

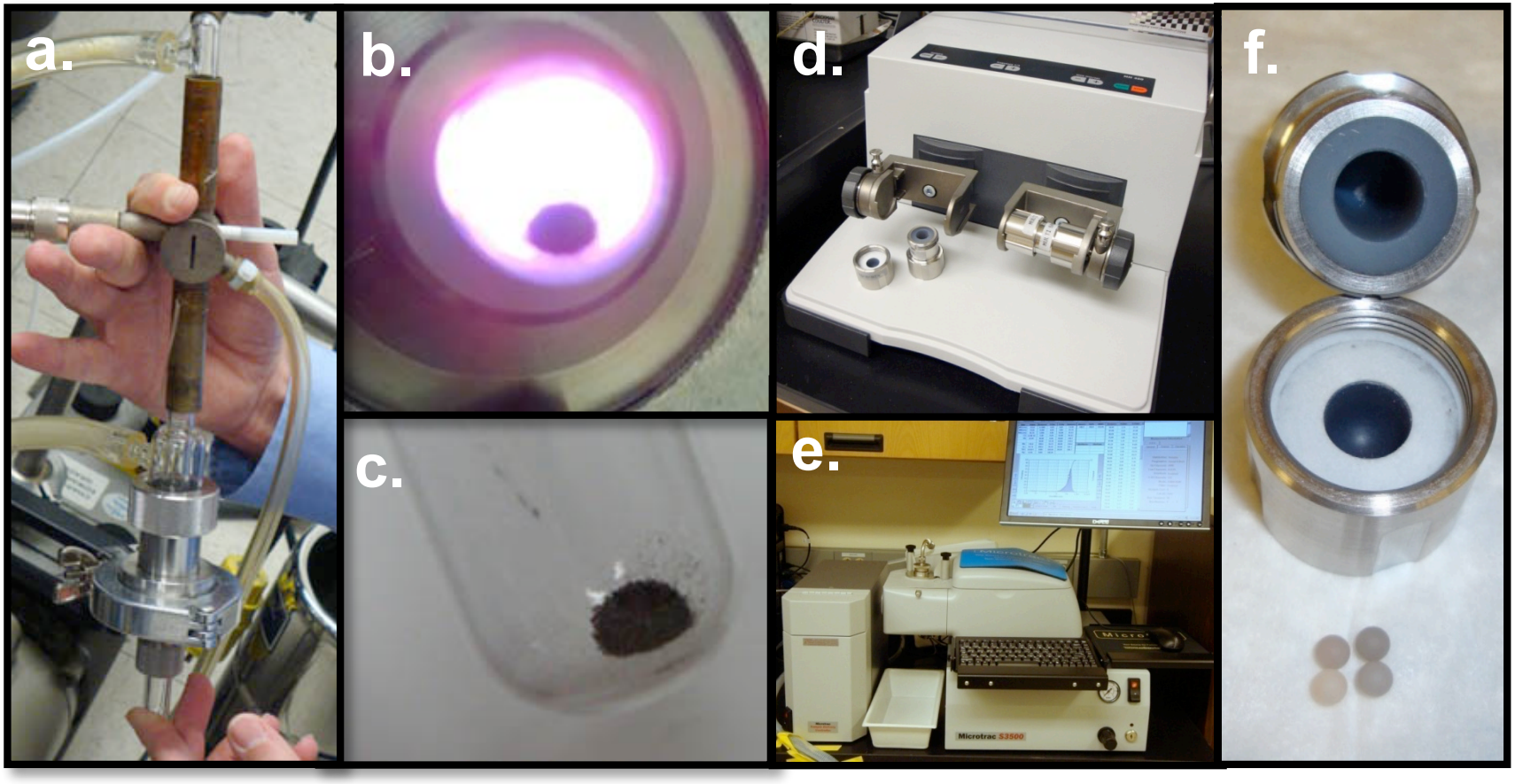


So the question becomes how do we measure $OH^{\bullet}$?

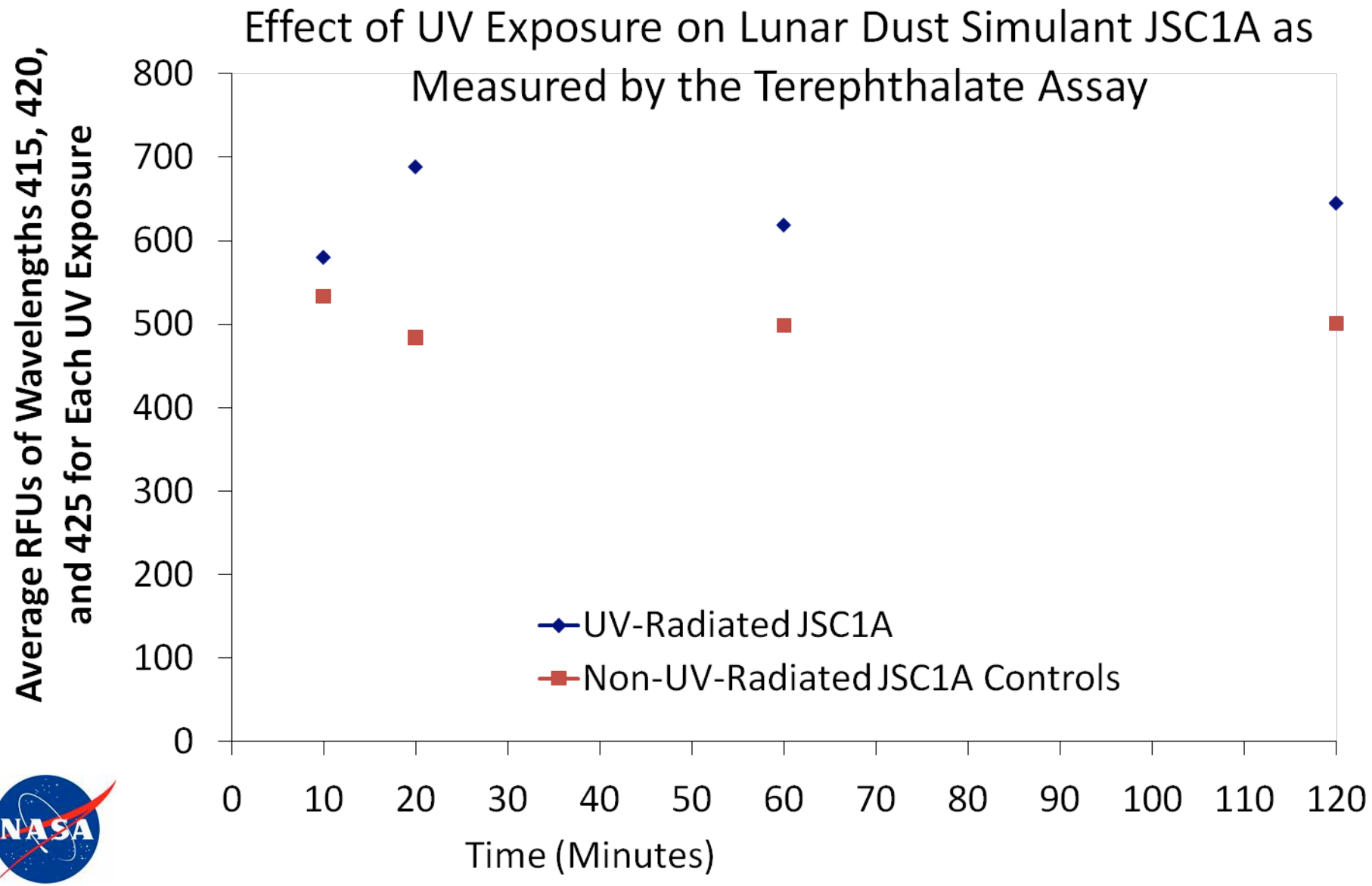


Excitation at 325 nm; Emission at 425 nm

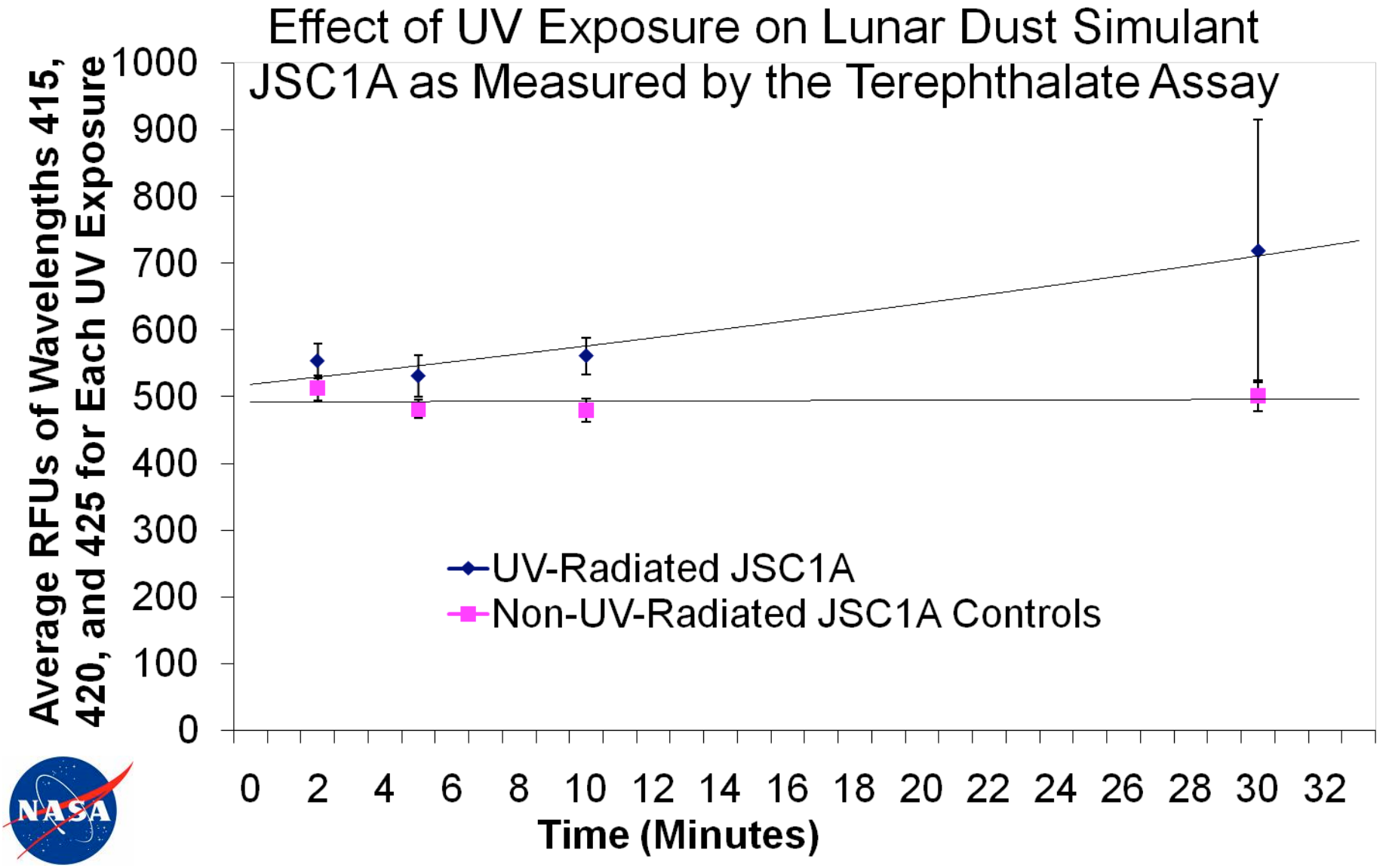
Instrumentation



Results


Effect of UV Exposure on Lunar Dust Simulant JSC1A as Measured by the Terephthalate Assay
Average RFUs of Wavelengths 415, 420, and 425 for Each UV Exposure
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Time (Minutes)
UV-Radiated JSC1A
Non-UV-Radiated JSC1A Controls

Results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0
UV-Radiated JSC1A
Non-UV-Radiated JSC1A Controls
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
Time (Minutes)

Conclusions

- The trend suggests that we are seeing increasing hydroxyl radical generation following UV exposure.

- The trend also suggests that between 30 and 60 minutes of UV exposure we see a plateau.

Future Directions

- To introduce a motion that causes the gardening of the soil during the irradiation procedure.

- To use a magnesium fluoride window to separate the hydrogen discharge from the sample chamber allowing us to determine if it is the UV that is causing the increased reactivity.

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UV System Details

- The vacuum ultraviolet radiation ~10.2 eV used to ionize the sample was generated by a microwave-powered, flowing hydrogen, discharge lamp.
- The lamp consists of a glass discharge tube mounted in a tunable McCarroll cavity that is powered by a 50–120 W microwave generator ~Opthos Instruments MPG 4M.
- The lamp, equipped with a removable MgF2 window, was mounted on one port of the cryogenic chamber during photolysis. With a 10% H2/helium mixture in a low-pressure discharge, much of the most energetic VUV radiation is practically monochromatic in the Lyman-a line ~121.6 nm.